

(Printed for Members Only.)

PRELIMINARY REPORT
OF THE
COMMITTEE ON STANDARDIZATION
OF
THE INSTITUTE OF RADIO ENGINEERS
Inc.

DEFINITIONS OF TERMS,
GRAPHICAL AND LITERAL SYMBOLS.

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NEW YORK CITY,

September 10, 1913.

PREFACE.

The early history of new branches of engineering always shows the discouraging spectacle of a confused and ill-defined nomenclature, together with widely different connotations assigned to the literal symbols by the various investigators and authors. Such a state of affairs gives rise to untortunate misunderstandings, or, at best, to a considerable amount of unnecessary labor on the part of the practicing engineer and students of engineering.

The field of radio engineering is far from having escaped the objectionable conditions mentioned above, as is easily seen from reading either theoretical papers on the subject or the reports of the patent lawsuits.

The Committee on Standardization of THE INSTITUTE OF RADIO ENGINEERS was appointed by the Past-President of the Institute, Mr. Robert H. Marriott, and continued by President Greenleaf W. Pickard, for the express purpose of studying the terms and symbols used in the art, selecting and defining the suitable terms, and eliminating the remainder. Its further functions are to develop, and make public, standard methods of testing and rating radio apparatus, and to consider such further matters as would naturally fall within the scope of a Committee on Standardization.

As a result of more than fifty meetings and discussions, the Committee presents to the I. R. E. members and others interested the following definitions and symbols for consideration.

All those interested are requested to send to the Committee, in care of the Secretary, their comments on the following preliminary report. Coöperation of this sort will be welcomed, and will assist the committee in the early publication of a final report.

TO ALL MEMBERS :

The questions given below should be answered, and this page should be torn out and mailed to Alfred N. Goldsmith (former Secretary of Committee on Standardization), The College of the City of New York, New York City. The final action on this Committee Report will be based on the replies received.

1. With the exception of the changes suggested by you below, are you in favor of the acceptance and adoption of this Preliminary Report by the Institute ?

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2. If you are not in favor of its acceptance, what are your reasons for its rejection ?

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3. What criticism of the Report do you make, and what changes in the Report do you suggest ?

.....
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(Further criticisms and suggestions may be sent on separate sheets.)

.....
Signature.

.....
Date.

DEFINITIONS OF TERMS.

Acoustic Resonance Device. One which utilizes in its operation mechanical or other resonance to the group frequency of the received impulses. The device most commonly used is a relay.

Air Condenser. One having air as its dielectric.

Alphabet or Code. (See "Code.")

Alternator. A rotating machine which transforms mechanical energy into electrical energy, delivering at its terminals one or more alternating E. M. F.'s. (Single phase or poly-phase.)

Alternating Current. One which reverses its direction successively with time, whether periodic or non-periodic. (See also Free Alternating Current, Forced Alternating Current.)

Ammeter. A current measuring instrument indicating in amperes or fractions thereof.

Amplification. The ratio of the useful effect obtained by the employment of the amplifier to the useful effect obtained without that instrument.

Amplifier or Amplifying Relay. One which modifies the effect of a local source of energy in accordance with the variations of received signals, and in general produces a larger indication than could be had from the incoming energy alone.

Angular Velocity of a periodic alternating current in radians per second. 2π times the frequency in cycles per second.

Antenna. A system of conductors designed for radiating or absorbing the energy of electromagnetic waves.

Antenna Resistance. The ohmic resistance in the entire antenna circuit.

The energy consumed in the antenna resistance contributes nothing to the radiation, but produces only heat.

Arc or Spark. See "Spark."

Arc Convertor. An arc used for (a) the conversion of alternating to pulsating direct current, or (b) the conversion of direct to alternating or pulsating current.

Arc Converters of Type (b) are classified as follows:

Class (1) Those for which the amplitude of the (approximately) sinusoidal current produced is less than that of the direct current.

Class (2) Those in which the amplitude of the (approximately) sinusoidal current is at least equal to that of the direct current, but in which the direction of the current is never reversed.

Class (3) Those in which the amplitude of the initial portion of the free alternating current is greater than the direct current passing through the converter, and in which the direction of flow of the current is periodically reversed.

Atmospheric Absorption. That portion of the total loss of radiated energy due to atmospheric conductivity, reflection, and refraction.

Atmospherics (Atmospheric Disturbances in the Receiver) may be classified as follows:

- (1) Electrical disturbances set up by distant discharges, and
- (2) Disturbances caused by contact of charged particles with the antenna, or by the contact of uncharged particles against the antenna and their consequent electrification.

Attenuation. The progressive diminution of intensity as a disturbance advances through a transmitting medium.

Attenuation Radio. The diminution of radiant electromagnetic energy concurrent with its passage thru a partially absorbing medium.*

Attenuation Coefficient (Radio).* The coefficient which, when multiplied by the distance of radiant transmission through a uniform medium gives the natural logarithm of the attenuation factor in that distance.

Attenuation Factor (Radio). The ratio of the radiant energy received at a distance traversed in an attenuating medium to the initial radiant energy. A numeric.

Audibility (Minimum). The condition in which there is present in the antenna the least power required for an audible

*See footnote on following page.

indication in the receiving telephones, with the particular apparatus employed.

Audibility Factor. The ratio of the telephone current producing the received signals to that producing the least audible signal at the given audio frequency.

(An audible signal is one which just permits the differentiation of dots and dashes.) The determination of the above ratio should be made by the usual non-inductive shunt-to-telephone method, pending the adoption by the Institute of a more suitable method. The audibility factor is, in general, proportional to the square of the ratio frequency is the antenna and is often stated as the vector $(R_t + R_s) / R_s$ where R_t is the audio frequency impedance of the telephones, and R_s is the impedance of the shunt which, when connected across the telephone terminals, reduces the signal to the point at which dots and dashes can be just distinguished from each other.

Audio Frequencies. The normally audible frequencies lying between 20 and 20,000 cycles per second. (See also Radio Frequencies.)

Brush or Coronal Losses. Those due to leakage convection current through a gaseous medium.

Capacity. That property of a material system by virtue of

***General Considerations for Spherical Wave Distribution.**

Assume that energy leaves a source. Because of geometrical considerations of the spread of energy (and depending on the nature of the waves), there will be a normal law of energy diminution with distance. At a distance s there will therefore be a normal energy intensity, no absorption of energy in the medium being as yet considered. Therefore (Normal Energy Intensity at Distance s) equals the product of (Energy Radiated) and (a Function of s). There may be, in addition, a dissipative absorption of energy in the medium. On the assumption that equal thicknesses of a homogeneous medium absorb equal portions of the thereupon incident energy: (Energy Intensity at a Distance s taking account of Distance Diminution and Medium Absorption) equals the product of (Normal Energy Intensity at distance s as defined above) and (e^{-As}) , where A is the attenuation coefficient. The actual energy intensity at distance s will, in general, be a function of (Energy Intensity at distance s taking account of Distance Diminution and Medium Absorption) and other physical conditions (e.g., ground losses, atmospheric reflection and refraction).

which it is capable of storing energy electrostatically.

The capacity of a system is dependent on its geometrical dimensions, its position relative to other conductors, and the dielectric constants of the surrounding media.

Capacity is measured by the ratio of the quantity of electricity stored to the potential difference at which it is stored.

A distinctive property of a capacity is that it permits the passage of electrical energy through it only in the form of displacement currents.

Capacity of An Antenna. Its electrostatic capacity measured relative to the counterpoise or ground.

Capacitive Coupler. An apparatus which electrostatically joins portions of two circuits, and thereby permits the transfer of electrical energy between these circuits thru the action of electric forces.

Capacity Reactance. A measure of that property of a circuit whereby the opposition of inductive reactance to change of an alternating current may be compensated or reversed. It is numerically equal to the reciprocal of the product of angular velocity and capacity in series with the inductance, and is always negative in sign.

Choke Coil, see Reactance Coil or Reactor.

Code (Alphabet). A system of conventional characters designed to represent letters by dots and dashes. The International Morse Code is official.

Coefficient of Coupling (Inductive). The ratio of the mutual inductance of two circuits to the square root of the product of the self-inductance of those circuits.

Coherer. A device sensitive to radio frequency energy, and characterized by (1) a normally high resistance to direct currents at low voltages, (2) a reduction in resistance on the application of an increasing electromotive force, this reduction persisting until eliminated by the application of a restoring or disturbing mechanical force, and (3) the substantial absence of thermo-electric or rectifying action.

Condenser. A material system possessing electrostatic capacity.

Conductive Coupler. An apparatus which magnetically and electrically joins two circuits having a common conductive portion (also known as a Direct Coupler).

Conductance of a conductor is numerically equal to the reciprocal of its ohmic resistance.

Conduction Current. A transfer of electrical energy guided by a conducting medium.

Convection Current. A transfer of electrical energy by separate charged particles, unguided by any material medium.

Counter Electromotive Force exists wherever there is one which opposes any electromotive force that tends to alter the flow of current in a circuit. If the counter electromotive force is due to the presence in the circuit of inductance or capacity or to thermo-electric forces, it may persist after the withdrawal of the electromotive force which was its cause; but in most other cases it persists only so long as the impressed electromotive force.

Counterpoise. A system of electrical conductors forming one plate of a condenser, the other plate of which is the ground. For alternating current, it may be used to replace a direct connection to ground.

Coupler. See Capacitive Coupler and Inductive Coupler.

Coupling. See Coefficient of Coupling (Inductive).

Critical Resistance of an oscillating circuit. Twice the square root of the ratio of the inductance of that circuit to the capacity of that circuit, both expressed in practical units. This term applies only to circuits capable of carrying free alternating currents.

Current. The time rate of transfer of electrical quantity.

Current. See also Convection Current, Conduction Current, Displacement Current, Alternating Current, R.M.S. Value.

Damping of a Circuit. The diminution of E.M. F. and current in that circuit resulting from the withdrawal of electrical energy.

Damping Factor of a simple circuit. The ratio of the effective resistance of that circuit to twice the effective inductance. (The reciprocal of a time.) This term applies only to circuits capable of carrying free alternating currents.

Decrement. See Linear and Logarithmic Decrement.

Detector. That portion of the receiving apparatus which, connected to a circuit carrying currents of radio-frequency, and in conjunction with a self-contained or separate indicator, translates the radio frequency energy into a form suitable for operation of the indicator. This translation may be effected either by the conversion of the radio frequency energy, or by means of the control of local energy by the energy received.

Dielectric. A medium that may be regarded as incapable of electric conduction, i.e., an insulator.

Dielectric Constant (or Specific Inductive Capacity) of a medium. The ratio of the capacity of a condenser having that medium as a dielectric to the capacity of a condenser having a vacuum dielectric but otherwise identical. (The dielectric constant of air is substantially unity, and therefore, for all practical purposes, air may be used in place of the vacuum in the comparison condenser.)

Dielectric Hysteresis. That lagging property of a dielectric which is measured by the energy lost when the rising and falling (displacement current)-(voltage) characteristics (dynamic) are not identical.

Dielectric Hysteretic Constant of a given dielectric. The value of the dielectric hysteresis per cycle per unit of potential gradient applied to the dielectric.

Dielectric Lag. That property of a dielectric which is evidenced by a dissimilarity, and general time lag, of the impressed (potential difference)-(time) curve as compared with resulting (displacement current)-(time) curve for a condenser having that dielectric.

Dielectric Strength. A measure of the ability of a dielectric to withstand without rupture the application of a difference of potential.

Diplex Operation involves either the simultaneous reception, or the simultaneous transmission, of two messages at one and the same station.

Discharger. An element of varying resistance in a circuit containing inductance, capacity, or both. Examples are spark gaps, commutators, arcs, etc.

Displacement Current. The electrical condition within a dielectric region of varying electric stress. It produces the same external electric and magnetic effects as the equivalent conduction current.

Duplex Operation involves simultaneously both transmission *and* reception at one and the same station.

Dynamic Characteristic of an Arc Converter, for a given frequency and between given extremes of impressed E.M.F. and resultant current through the arc. The relation given by the curve obtained when the impressed E.M.F. is plotted against the resultant current, both E.M.F. and current varying at the given frequency.

Dynamic Characteristic of a Dielectric for a given potential gradient applied to a given dielectric at a given frequency. The curve obtained when displacement current is plotted against the sinusoidally varying difference of potential.

Eddy Currents. Those induced in conducting masses by external varying magnetic fields, the location of these currents being primarily determined by the position of the fields and not by the configuration of the conducting mass. (That is, the conducting mass is not specially arranged to provide perfectly well-defined circuits.) Such parasitic currents are also called Foucault currents.

Effective Capacity of An Antenna. That capacity which, connected in series with an inductance of appropriate value, will give a circuit whose reactance for all practical purposes is equivalent to that of the antenna throughout the working range of frequencies. The effective capacity of an antenna is, in general, less than the electrostatic capacity of the antenna, and depends on the potential distribution along the antenna.

Effective Resistance of a Spark. The ratio of the heat produced in that spark in a complete free alternating current group to the square of the R.M.S. value of the current during that time.

Efficiency of any element of a system, or of that system. The ratio of the available and useful output to the input, both measured in the same units.

Electric Charge. Quantity of electricity, definitely situated.

Electrical Potential at any point is measured by the work done in carrying a unit charge of electricity from infinity to the point considered. (See Electromotive Force.)

Electric Stress. The cause of the electrically strained condition in the medium between two regions which are at different potentials

Electromagnetic Wave. A progressive disturbance characterized by the existence on the wave front of electric and magnetic forces acting in directions which are perpendicular to each other and to the direction of propagation of the wave.

Electromotive Force. The force which tends to displace electricity, and is proportional to the difference of potential between the two points considered.

Forced Alternating Current. One produced in any circuit by the application of an alternating electromotive force. See also Free Alternating Current.

Form Factor of an open oscillator. The ratio of the average value of the R.M.S. currents measured at all points along that oscillator to the greatest of these R. M. S. currents. For a given R.M.S. current at a current antinode in the oscillator, the field intensity at distant points is proportional to the form factor.

Free Alternating Current. That produced by an isolated electrical displacement in a circuit having capacity, inductance, and *less* than the critical resistance. See also Forced Alternating Current.

Frequency. See Audio Frequency and Radio Frequency.

Frequency Meter. An instrument which indicates the audio frequency of a source of electrical power.

Gas Rectifier. A body of ionised gas having unilateral conductivity, together with means for utilizing this property.

Group Frequency. The number of distinguishable alternating current groups occurring per second in an electrical circuit.

Note 1. The group referred to above is, in general, mainly a free alternating current which is substantially damped to extinction before the beginning of the following group or train.

Note 2. The pitch of the note in the receiving station is, in general, determined by the group frequency at the transmitting station.

Note 3. The term Group Frequency replaces the term "Spark Frequency."

Hysteresis. See Dielectric Hysteresis and Magnetic Hysteresis.

Hot Wire Ammeter. An ammeter dependent for its indications upon the changes in dimensions of an element which is changed in temperature by the passage through it of a current.

Impedance. Total opposition to current flow in a circuit in which the current is varying, and is numerically equal to the square root of the sum of the squares of the ohmic resistance and the total reactance of the circuit.

Impulse Excitation. The term applied to a method of producing free alternating currents of relatively small damping by means of the actual or equivalent removal of a source of highly damped free alternating currents from the coupled secondary circuit. As a special case, the primary current may be very highly damped, but in all cases there must be, in effect, a suppression of reaction between the circuits.

Impulse excitation is obtained in the secondary of two coupled circuits of decrements d_1 and d_2 , coupling coefficient k , provided that either

- (a) k^2 is small compared with $(d_1 d_2 / \pi^2)$, when the primary contains no spark gap, or
- (b) thru the use in the primary of a spark discharger the resistance of which increases with time or diminished electromotive force, and the partial fulfillment of condition (a) above.

Note: Under the conditions of impulse excitation:

- (1) The decrement of the free alternating current in the secondary circuit is appreciably that of the secondary circuit.
- (2) The reaction of the secondary circuit on the primary, at least in so far as the production of the coupling frequencies is concerned, is negligible.

Inductance. That property of a material system by virtue of which it is capable of storing energy electromagnetically.

The inductance of a system is dependent upon its geometrical dimensions and the permeability of the surrounding media. In hysteresis-free circuits, inductance is measured by the ratio of the energy stored in the magnetic field surrounding a current-carrying conductor to the square of the current in that conductor, for stationary conditions. In any circuit, it may be measured by the interlinkage with the system itself of magnetic lines of force due to unit current passing through the system. An alternative method involves the measurement of the counter electromotive force at the terminals of the given conductor when the current through the conductor changes at the rate of one unit of current per second. In hysteresis-free circuits these three methods of measurement yield identical results.

Inductance. See also Mutual Inductance and Self Inductance.

Inductive Coupler. An apparatus which magnetically joins portion of two circuits.

Inductive Reactance. A measure of the opposition to an alternating current produced by the presence of inductance in a circuit, and is numerically equal to the product of the Angular Velocity and the Inductance in the circuit.

Key. A switch arranged for rapidity of manual operation.

Line of Force. A curve described in an electric or magnetic field such that the electric or magnetic force is at all points of that curve tangentially directed to it.

Linear Decrement of a circuit containing a resistance element equivalent to a spark: The difference of successive current amplitudes in the same direction divided by the larger of these amplitudes. (In circuits containing such an element, not the ratio of successive current amplitudes, but their difference is constant, and characteristic of the damping.)

Logarithmic Decrement of a circuit containing inductance, capacity, and constant resistance is one half the ratio of the electrical energy withdrawn from that circuit during a cycle to the total energy present in that circuit at the beginning of the cycle. It also equals the natural logarithm of the ratio of successive current amplitudes in the *same* direction. Note: Logarithmic decrements are standard for a complete period or *cycle*.

Magnetic Field Intensity. The flux density of magnetic lines of force produced by a magnetomotive force in air (or in a vacuum).

Magnetic Force at a point. The force acting on a unit magnetic pole placed at that point. It is numerically equal to the field intensity in a medium of unit permeability.

Magnetic Hysteresis. That property of a magnetic medium which is measured by the energy losses, when the rising and falling (magnetomotive force)-(induction), i. e. (H-B), dynamic characteristics are not identical.

Magnetic Hysteretic Constant for a given material. The value of the magnetic hysteresis per cycle per unit induction for that medium.

Magnetic Induction. The magnetic flux density in a magnetic medium.

Magnetomotive Force. A force tending to produce a magnetic flux.

Microphone. An electrical contact, the resistance of which is directly and materially altered by slight mechanical disturbances.

Mutual Inductance of two circuits, each on the other, is that portion of the inductance of one due to the magnetic field common to both.

Oscillograph. A device for continuously indicating the wave form of a varying electrical quantity, e.g., voltage, current, power, etc.

Oscillating Circuit. One in which free alternating currents exist. It therefore contains less than the critical resistance.

Note: *Forced* alternating currents may be produced in circuits containing *any* combination of inductance, capacity and resistance, and resonant effects may be produced in any circuit if all three of the electrical quantities above mentioned are present.

Oscillations. See Alternating Currents, Free and Forced.

Permeability of a medium. The ratio of the magnetic flux density produced in that medium by a given magnetomotive force to the magnetic flux density produced by the same magnetomotive force in vacuum (or for practical purposes, in air).

Potential. See Electric Potential.

Radiation Resistance is the difference between the apparent total antenna resistance and the sum of all resistances which give rise to measurable dissipative energy losses, at a given wave length. This quantity is to be distinguished from antenna resistance.

Radio Communication. The radio transmission of intelligible signals.

Radio Frequencies. Those above 20,000 cycles per second. See also Audio Frequencies.

It is not implied that radiation cannot be secured lower frequencies and the distinction from audio frequencies is merely one of convenience.

Radio Frequency Resistance of a conductor. The ratio of the heating in watts to the square of the R.M.S. current in the conductor.

Radiogram. A message sent by radio communication.

Radio Telegraphy and Radio Telephony. Further divisions of radio communication. It is proposed that the term "wireless" shall be entirely eliminated, as inaccurate and inappropriate.

Reactance, (Total of a Circuit) is measured by the algebraic sum of the capacity reactance and the inductive reactance. See also Capacity Reactance and Inductive Reactance.

Reactance Coil or Reactor. A form of stationary induction apparatus used to supply reactance or produce phase displacement. (It is essentially an inductive resistor.)

Rectifier. A device which, when supplied with alternating current deliver unidirectional current.

Relay Key. An electrically operated key or switch.

Reluctance of a magnetic path determines the magnetic flux produced by a given magnetomotive force, and is numerically equal to the ratio of the second of these quantities to the first.

Resistance. The measure of that property of a conductor by the action of which electrical energy is transformed into heat in that conductor. It is numerically equal to the ratio of the heat energy liberated per second, measured in watts, to the square of the current in the circuit, for stationary conditions; it is also equal to the ratio of the applied electromotive force to the resulting current, both being constant.

Resonance to an Alternating Current at a given frequency. That circuit condition in which the inductive reactance at that frequency is numerically equal to the capacity reactance at that frequency; that is, the apparent reactance is zero.

Resonance Curve gives the relation between circuit energy, current, or voltage at various frequencies of excitation as a function of those frequencies.

A Standard Wave Length Resonance Curve. One wherein the abscissas are ratios of specified wave lengths to the resonant wave length, and the ordinates are ratios of the energy (or square of the current) at corresponding specified wave lengths to the energy (or square of the current) at the resonant wave length. The scale of ordinates and abscissas shall be equal.

A Standard Frequency Resonance Curve. One wherein the abscissae are ratios of specified frequencies to the resonant frequency, and the ordinates are ratios of the energy (or square of the current) at corresponding specified frequencies to the energy (or square of the current) at the resonant frequency. The scales of ordinates and abscissae shall be equal.

A Standard Resonance Curve, unless otherwise specified, is assumed to be a standard wave length resonance curve.

Resonance: See Sharpness of Resonance.

R. M. S. (Root-Mean-Square) Value of a current or electromotive force: the square root of the mean value of the squares of the instantaneous values of the current or electromotive force for any given number of cycles. The R. M. S. value of an alternating current is also the value of that direct current which produces an equal heating effect when flowing for the same time.

Selecting. The process of adjusting an element driven by a plurality of simultaneous impulses, until the ratio of desired response to undesired response is a maximum.

Selectivity of a driven element is a maximum when its damping is a minimum consistent with the use of the given indicator.

Self Inductance of a circuit. That portion of the inductance which is due to the magnetic field produced by the current in that circuit. See also Inductance.

Sharpness of Resonance of a circuit of logarithmic decrement d_2 coupled to one of decrement d_1 is defined as

$$2\pi / (d_1 + d_2).$$

It is a measure of the steepness of the resonance curve obtained from the secondary circuit. It is also a measure of the amount of detuning necessary to secure a halved-squared-current value, at very loose couplings. In circuits having linear decrements, d_1 and d_2 must be taken at the average value of the logarithmic decrements.

Skin Effect of varying currents. The non-uniform current density thru the cross section of the conductor.

Space Waves. Electromagnetic waves in a homogeneous insulator. Their distinguishing characteristic is that their energy varies inversely with the square of the distance from the source for distances great in comparison with the wave length, neglecting absorption.

Spark (or Arc) A body of ionised (and therefore conducting) gas which permits and accompanies a disruptive electric discharge. There is no sharp line of demarcation between arcs and sparks. See also Effective Resistance of a Spark.

Static Characteristic of an Arc. The relation given by the curve plotted between the impressed electromotive force and the resultant current thru the arc for substantially stationary conditions.

Surface Density of Electrification at any point of a surface is the charge of electricity per unit area at that point.

Surface Waves. Electric waves which follow the surface of a conductor.

Their distinguishing characteristics are

(a) That if they radiate over a plane sheet, at considerable distances their energy varies inversely with the distance, neglecting medium absorption, and

(b) That they are subject to medium absorption, that is, dissipation of their energy thru its conversion into heat in the guiding conductor.

Sustained Radiation consists of electromagnetic waves of constant amplitude (such as are emitted from an antenna in which flows a forced alternating current).

Transformer. A stationary induction apparatus which changes electric energy in a primary coil into electric energy in a secondary coil thru the medium of magnetic energy. As applied in radio engineering, it should refer exclusively to the so-called "power transformer."

Tuning. The process of securing the maximum indication by adjusting the time period of a driven element. (In transmitter or receiver.)

Waves: See Surface Waves and Space Waves.

Wave Length. The shortest distance between two points in a sustained plane wave group or train such that magnitude and rate of change of magnitude of the disturbances at those points are completely identical. In general, it is twice the distance between a point of zero disturbance and the next point of zero disturbance. Wave length should always be expressed in meters.

Wave Meter. A radio frequency measuring instrument calibrated to read wave lengths.

LITERAL SYMBOLS.

1. (Symbols arranged alphabetically).

Units used should be those of PRACTICAL SYSTEM, e. g., the volt, ampere, ohm, henry, farad, etc., and their multiples and submultiples. The inductances and capacities in radio frequency circuits should be normally expressed in microhenrys and microfarads respectively.

a	Damping Factor (that is, $R/2L$) (Time reciprocal)
A	Attenuation Coefficient (Distance Reciprocal)
A_f	Audibility Factor
b	Linear Decrement (Numeric)
B	Magnetic Induction
c	Capacity (at audio frequencies) (Farads)
C	Capacity (at radio frequencies) (Farads)
C_d	Distributed Capacity (Farads)
d	Logarithmic Decrement (that is, $RT/2L$) (Numeric)
e	Instantaneous Value of Voltage. May also be used for E. M. F. of individual cells of a battery or accumulator, etc.) (Volts)
E	R. M. S. Value of Voltage (Volts)
E_m	Maximum Value of Voltage, (Amplitude) (Volts)
E_R	Resonance Voltage (Volts)
EFF	Efficiency (Numeric)
h	Effective Height of Antenna (Meters)
ht	Actual height (e. g. of antenna) (Meters)
H	Magnetic Force (Gilberts per cm.)
i	Instantaneous Value of Current (Amperes)
I	R. M. S. Value of Current (Amperes)
I_m	Maximum Value of Current (Amplitude) (Amperes)
I_R	Resonance Current (Amperes)
I_r	Received Current (Amperes)
I_s	Transmitting (Antenna) Current
j	$\sqrt{-1}$
k	Coefficient of Inductive Coupling (that is, $\sqrt{\frac{M}{L_1 L_2}}$) (Numeric)
K	Dielectric Constant (Specific Inductive Capacity)
k_c	Coefficient of Capacity Coupling (Numeric)
l	Inductance (at audio frequencies) (Henrys)
L	Inductance (at radio frequencies) (Henrys)
L_d	Distributed Inductance (Henrys)

M	Coefficient of Mutual Inductance (Henrys)
n	Frequency, in complete cycles
N	Group Frequency (e. g., sparks per second)
p	Instantaneous Value of Power (Watts)
P	Mean Value of Power (Watts)
PF	Power Factor (Numeric)
Q	Quantity of Electricity (Coulombs)
r	Resistance (at audio frequencies) (Ohms)
R	Resistance (at radio frequencies) (Ohms)
R_a	Apparent Total Antenna Resistance (Ohms)
R_f	Radiation Resistance (Ohms)
s	Distance (between stations, e. g.) (Km.)
t	Time (as a variable) (Seconds)
T	Period of one Cycle or Complete Oscillation (Seconds)
W	Energy (Joules, or Watt-hours)
W_e	Electrical Energy (Joules, or Watt-hours)
W_m	Magnetic Energy (Joules, or Watt-hours)
X	Reactance. (When X is positive, it denotes preponderance of inductive reactance, and when X is negative it denotes preponderance of capacity reactance.) Reactance always equals $2\pi nL - (1 - 2\pi nC)$
Z	Impedance (It is the square root of the sums of the squares of the resistance and the reactance of a circuit.) $R + jL\omega$ represents inductive impedance and $R - (j/C\omega)$ represents impedance containing capacity reactance component. (Ohms)

$$Z = \sqrt{R^2 + \left(L\omega - \frac{1}{\omega C}\right)^2}$$

a	Form Factor (of antennae) (Numeric)
μ	Permeability
μa	Microampere
μv	Microvolt
μw	Microwatt
μh	Microhenry
μf	Microfarad

(In general, the prefix μ shall indicate "Micro," and the letter "m," used as a prefix, shall indicate "milli.")

λ	Wave Length (Meters)
ϕ	Magnetic Flux (Maxwells)
ω	Angular Velocity, that is 2π times the frequency (Radians per second.)



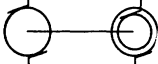



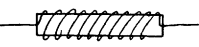


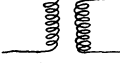

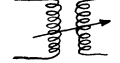

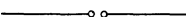
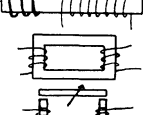

LITERAL SYMBOLS.

2. (*Arranged alphabetically according to the terms symbolized*).


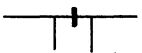



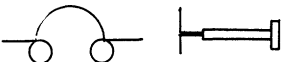
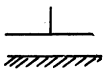
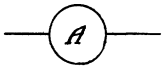
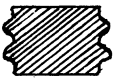


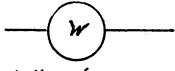
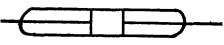
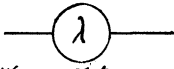
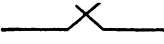
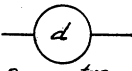

ht	Actual Height (e. g. of antenna) (Meters)
ω	Angular Velocity, that is 2π times the frequency. (Radians per second.)
R_a	Apparent Total Antenna Resistance (Ohms)
A	Attenuation Coefficient (Distance reciprocal)
A_f	Audibility Factor
c	Capacity (at audio frequencies) (Farads)
C	Capacity (at radio frequencies) (Farads)
k_c	Coefficient of Capacity Coupling (Numeric)
k	Coefficient of Inductive Coupling (that is, (Numeric) $\sqrt{\frac{M}{L_1 L_2}}$)
M	Coefficient of Mutual Inductance (Henrys)
a	Damping Factor, (that is, $R/2L$) (Time reciprocal)
K	Dielectric Constant (Specific Inductive Capacity)
s	Distance (between stations, e. g.) (Km.)
C_d	Distributed Capacity (Farads)
L_d	Distributed Inductance (Inductance)
h	Effective Heights of Antenna (Meters)
EFF	Efficiency (Numeric)
W_e	Electrical Energy (Joules, or Watt-hours)
W	Energy (Joules, or Watt-hours)
δ	Form Factor (of antennae) (Numeric)
n	Frequency, in complete cycles
N	Group Frequency (e. g., sparks per second)
Z	Impedance (It is the square root of the sums of the squares of the resistance and the reactance of a circuit). $R + jL\omega$ represents inductive impedance and $R - (j/C\omega)$ represents impedance containing a capacity reactance component. (Ohms)
	$Z = \sqrt{R^2 + \left(L\omega - \frac{1}{\omega C}\right)^2}$
i	Instantaneous Value of Current (Amperes)
p	Instantaneous Value of Power (Watts)
e	Instantaneous Value of Voltage (May also be used for E. M. F. of individual cells of a battery or accumulator, etc.) (Volts)

l	Inductance (at audio frequencies) (Henrys)
L	Inductance (at radio frequencies)
b	Linear Decrement (Numeric)
d	Logarithmic Decrement (that is $RT/2L$) (Numeric)
W_m	Magnetic Energy (Joules, or Watt-hours)
ϕ	Magnetic Flux (Maxwells)
H	Magnetic Force (Gilberts per cm.)
B	Magnetic Induction
I_m	Maximum Value of Current (Amplitude), (Amperes)
E_m	Maximum Value of Voltage (Amplitude), (Volts)
P	Mean Value of Power (Watts)
μa	Microampere
μf	Microfarad
μh	Microhenry
μv	Microvolt
μw	Microwatt
T	Period of one Cycle or Complete Oscillation (Seconds)
μ	Permeability
PF	Power Factor (Numeric)
Q	Quantity of Electricity (Coulombs)
R_f	Radiation Factor (Ohms)
X	Reactance. (When X is positive, it denotes preponderance of inductive reactance, and when X is negative it denotes preponderance of capacity reactance.) Reactance always equals $2\pi nL - (1/2\pi nC)$
r	Resistance (at audio frequencies) (Ohms)
R	Resistance (at radio frequencies) (Ohms)
I_r	Received Current (Amperes)
I_R	Resonance Current (Amperes)
E_R	Resonance Voltage (Volts)
I	R. M. S. Value of Current (Amperes)
E	R. M. S. Value of Voltage (Volts)
j	Square root of minus one ($\sqrt{-1}$)
t	Time (as a variable) (Seconds)
I_s	Transmitting (Antenna) Current
λ	Wave Length (Meters)

GRAPHICAL SYMBOLS.

 <p><i>Prime Mover</i></p>	 <p><i>Condenser</i></p>
 <p><i>Motor Generator</i></p>	 <p><i>Variable Condenser</i></p>
 <p><i>Non-Inductive Resistance</i></p>	 <p><i>Inductance</i></p>
 <p><i>Ferric Inductance</i></p>	 <p><i>Variable Inductance</i></p>
 <p><i>Key</i></p>	 <p><i>Inductive Coupler</i></p>
 <p><i>Telephone Transmitter</i></p>	 <p><i>Variable Inductive Coupler</i></p>
 <p><i>Relay</i></p>	 <p><i>Spark Gap</i></p>
 <p><i>Transformers</i></p>	 <p><i>Quenching Gap</i></p>

GRAPHICAL SYMBOLS

TESTS AND RATING.

The Committee on Standardization has further planned a series of preliminary recommendations relating to testing and rating apparatus for radio transmission. This work is in progress, and will be further reported in the future. The two following rules are, however, of sufficient importance to warrant submitting them to the radio engineering profession for immediate criticism and suggestion.

1. All radio transmitting sets shall be rated in actual power output measured in the antenna.

The Committee is aware of some of the theoretical and practical difficulties involved in making a measurement of the actual power output in an antenna, but is convinced that they are far from sufficient to justify discarding this unquestionably just method of rating. The group or audio frequency of the note of the station should be stated as well, (except for sustained wave sets, where that characteristic should be mentioned).

2. The over-all efficiency of a radio transmitting station shall be the quotient of the actual power* output measured in the antenna to the power* input supplied to the first piece of electrical machinery which is definitely a part of the radio equipment.

* Or the corresponding total energy, as explained below.

Examples of the application of this rule are the following: (a)

A ship station. Direct current is supplied from the ship's mains to a motor generator set, which furnishes alternating current to the high tension transformer of the radio set. The ratio of power in the antenna to power supplied to the motor of the motor generator set and to the auxiliary radio equipment (e. g., blower motors, rotary gap motors) is the over-all efficiency.

(b) An auxiliary ship station. Storage batteries are charged from the ship's mains, and operate a motor generator set or an induction coil. The over-all efficiency is the ratio of the kilowatt-hours supplied to the storage battery for a full charge to the kilowatt-hours delivered by the antenna circuit during the complete time of discharge. The energy ratio, rather than the power ratio, is here required, because of the method of storing energy in such batteries. It may be conveniently measured by the ratio of (kilowatt-hours on discharge of the storage battery to kilowatt-hours on charge) multiplied by the ratio of (power delivered in the antenna to power supplied by the storage battery to the radio equipment.) This method is closely approximate.

(c) A land station. High voltage alternating current (2,200 volts, for example) is supplied to the station from local power mains. This is stepped down to operate a motor generator set which supplies current of the definite type desired for the station. The over-all efficiency is the ratio of the power output of the antenna to the power supplied by the step-down transformer. If the step down transformer feeds other electrical machinery or apparatus not a part of the radio equipment, (e. g., lamps), the power supplied to such apparatus shall be subtracted from the total power supplied by the step-down transformer when calculating the over-all efficiency. If the motor generator in question is used to charge storage batteries which operate the station, an energy ratio, somewhat as in case (b) above, must be taken instead of the power ratio.

(d) A land station. A large steam engine operates directly or indirectly an audio or radio frequency alternator which supplies current to the radio station exclusively. The over-all efficiency is the ratio of the power output in the antenna to the brake kilowatts of the engine driving the alternator.

(e) A land station. A steam or gasoline engine drives a high voltage direct current generator which feeds directly or indirectly arcs or special gap discharges in the station. The ratio of the antenna power to the brake kilowatts of the engine is the over-all efficiency, (under similar conditions to those of (c) above.)